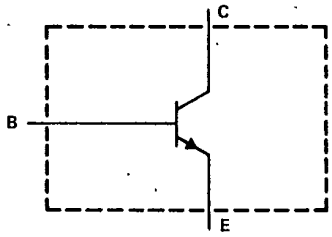
TIP33, TIP33A, TIP33B, TIP33C, TIP33D, TIP33E, TIP33F
N-P-N SILICON POWER TRANSISTORS

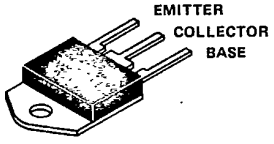
JULY 1968 – REVISED OCTOBER 1984

- Designed for Complementary Use With TIP34 Series
- 80 W at 25°C Case Temperature
- 10 A Continuous Collector Current
- 15 A Peak Collector Current
- Minimum f_T of 3 MHz at 10 V, 0.5 A
- Customer-Specified Selections Available
- Designed for Power Amplifier and High-Speed Switching Applications

device schematic



TO-218AA PACKAGE



THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE MOUNTING TAB

absolute maximum ratings at 25°C case temperature (unless otherwise noted)

	TIP33	TIP33A	TIP33B	TIP33C
Collector-base voltage	80 V	100 V	120 V	140 V
Collector-emitter voltage (I_B = 0)	40 V	60 V	80 V	100 V
Emitter-base voltage	5 V			
Continuous collector current	10 A			
Peak collector current (see Note 1)	15 A			
Continuous base current	3 A			
Safe operating area at 25°C case temperature	See Figure 4			
Continuous device dissipation at 25°C case temperature (see Note 2)	80W			
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	3.5 W			
Unclamped inductive load energy (see Note 4)	62.5 mJ			
Operating collector junction and storage temperature range	−65°C to 150°C			
Lead temperature 3,2 mm (0.125 inch) from case for 10 seconds	250°C			

NOTES: 1. This value applies for t_w = 0.3 ms, duty cycle ≤ 10%.
2. Derate linearly to 150°C case temperature at the rate of 0.64 W/°C.
3. Derate linearly to 150°C free-air temperature at the rate of 28 mW/°C.
4. This rating is based on the capability of the transistor to operate safely in the circuit in Figure 2.

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TIP33, TIP33A, TIP33B, TIP33C, TIP33D, TIP33E, TIP33F
N-P-N SILICON POWER TRANSISTORS

absolute maximum ratings at 25°C case temperature (unless otherwise noted)

	TIP33D	TIP33E	TIP33F
Collector-base voltage	160 V	180 V	200 V
Collector-emitter voltage (I_B = 0)	120 V	140 V	160 V
Emitter-base voltage	5 V		
Continuous collector current	10 A		
Peak collector current (see Note 1)	15 A		
Continuous base current	3 A		
Safe operating area at 25°C case temperature	See Figure 4		
Continuous device dissipation at 25°C case temperature (see Note 2)	80 W		
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	3.5 W		
Unclamped inductive load energy (see Note 4)	62.5 mJ		
Operating collector junction and storage temperature range	−65°C to 150°C		
Lead temperature 3,2 mm (0.125 inch) from case for 10 seconds	250°C		

NOTES: 1. This value applies for t_w = 0.3 ms, duty cycle ≤ 10%.
2. Derate linearly to 150°C case temperature at the rate of 0.64 W/°C.
3. Derate linearly to 150°C free-air temperature at the rate of 28 mW/°C.
4. This rating is based on the capability of the transistor to operate safely in the circuit in Figure 2.

electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	TIP33		TIP33A		TIP33B		TIP33C		UNIT
		MIN	TYP MAX	MIN	TYP MAX	MIN	TYP MAX	MIN	TYP MAX	
$V_{(BR)CEO}$	I_C = 30 mA, I_B = 0, See Note 5	40		60		80		100		V
I_{CEO}	V_{CE} = 30 V, I_B = 0		0.7		0.7					mA
	V_{CE} = 60 V, I_B = 0						0.7		0.7	
I_{CES}	V_{CE} = 80 V, V_{BE} = 0		0.4							mA
	V_{CE} = 100 V, V_{BE} = 0				0.4					
	V_{CE} = 120 V, V_{BE} = 0						0.4			
	V_{CE} = 140 V, V_{BE} = 0								0.4	
I_{EBO}	V_{EB} = 5 V, I_C = 0		1		1		1		1	mA
h_{FE}	V_{CE} = 4 V, I_C = 1 A, See Notes 5 and 6	40		40		40		40		
	V_{CE} = 4 V, I_C = 3 A, See Notes 5 and 6	20	100	20	100	20	100	20	100	
V_{BE}	V_{CE} = 4 V, I_C = 3 A, See Notes 5 and 6		1.6		1.6		1.6		1.6	V
	V_{CE} = 4 V, I_C = 10 A, See Notes 5 and 6		3		3		3		3	
$V_{CE(sat)}$	I_B = 0.3 A, I_C = 3 A, See Notes 5 and 6		1		1		1		1	V
	I_B = 2.5 A, I_C = 10 A, See Notes 5 and 6		4		4		4		4	
h_{fe}	V_{CE} = 10 V, I_C = 0.5 A, f = 1 kHz	20		20		20		20		
$\|h_{fe}\|$	V_{CE} = 10 V, I_C = 0.5 A, f = 1 MHz	3		3		3		3		

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2%.
6. These parameters are measured with voltage-sensing separate from the current-carrying contacts.

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N-P-N SILICON POWER TRANSISTORS

electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS		TIP33D		TIP33E		TIP33F		UNIT
			MIN	TYP MAX	MIN	TYP MAX	MIN	TYP MAX	
$V_{(BR)CEO}$	I_C = 30 mA, See Note 5	I_B = 0,	120		140		160		V
I_{CEO}	V_{CE} = 90 V,	I_B = 0		0.7		0.7		0.7	mA
I_{CES}	V_{CE} = 160 V,	V_{BE} = 0		0.4					mA
	V_{CE} = 180 V,	V_{BE} = 0				0.4			
	V_{CE} = 200 V,	V_{BE} = 0						0.4	
I_{EBO}	V_{EB} = 5 V,	I_C = 0		1		1		1	mA
h_{FE}	V_{CE} = 4 V, See Notes 5 and 6	I_C = 1 A,	40		40		40		
	V_{CE} = 4 V, See Notes 5 and 6	I_C = 3 A,	20		20		20		
V_{BE}	V_{CE} = 4 V, See Notes 5 and 6	I_C = 1 A,		1.6		1.6		1.6	V
	V_{CE} = 4 V, See Notes 5 and 6	I_C = 10 A,		3		3		3	
$V_{CE(sat)}$	I_B = 0.3 A, See Notes 5 and 6	I_C = 3 A,		1		1		1	V
	I_B = 3.3 A, See Notes 5 and 6	I_C = 10 A,		4		4		4	
h_{fe}	V_{CE} = 10 V, f = 1 kHz	I_C = 0.5 A,	20		20		20		
$\|h_{fe}\|$	V_{CE} = 10 V, f = 1 MHz	I_C = 0.5 A,	3		3		3		

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2%.
6. These parameters are measured with voltage-sensing separate from the current-carrying contacts.

thermal characteristics

PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JC}$			1.56	°C/W
$R_{\theta JA}$			35.7	

resistive-load switching characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS †			MIN	TYP	MAX	UNIT
t_{on}	I_C = 6 A,	I_{B1} = 0.6 A,	I_{B2} = −0.6 A,		0.6		μs
t_{off}	$V_{BE(off)}$ = −4 V,	R_L = 5 Ω,	See Figure 1		1		

† Voltage and current values shown are nominal; exact values vary slightly with transistor parameters.

TIP33, TIP33A, TIP33B, TIP33C,
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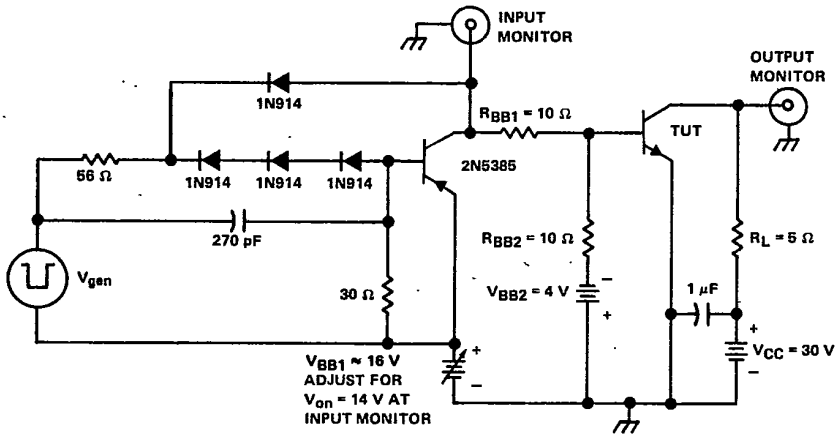
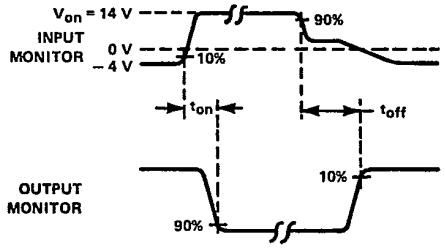
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

NOTES: A. V_{gen} is a − 30-V pulse into a 50 Ω termination.
B. The V_{gen} waveform is supplied by a generator with the following characteristics: $t_r \leq 15$ ns, $t_f \leq 15$ ns, $Z_{out} = 50\ \Omega$, $t_w = 20\ \mu s$, duty cycle ≤ 2%.
C. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 15$ ns, $R_{in} \geq 10\ M\Omega$, $C_{in} \leq 11.5$ pF.
D. Resistors must be noninductive types.
E. The d-c power supplies may require additional bypassing in order to minimize ringing.

FIGURE 1. RESISTIVE-LOAD SWITCHING

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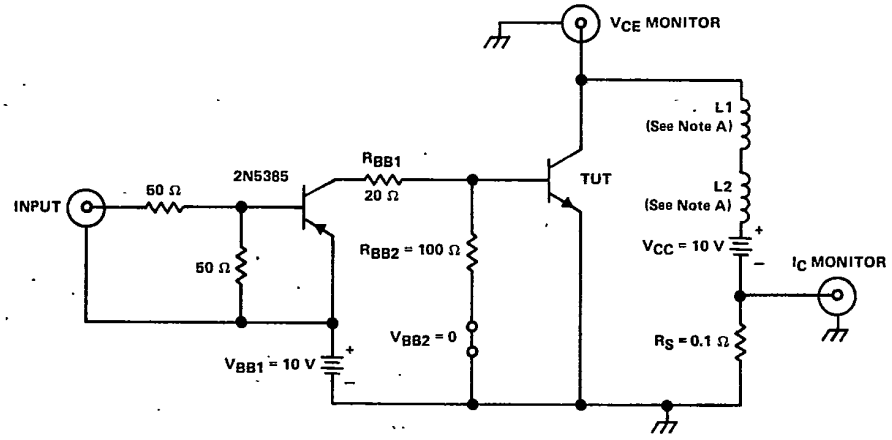
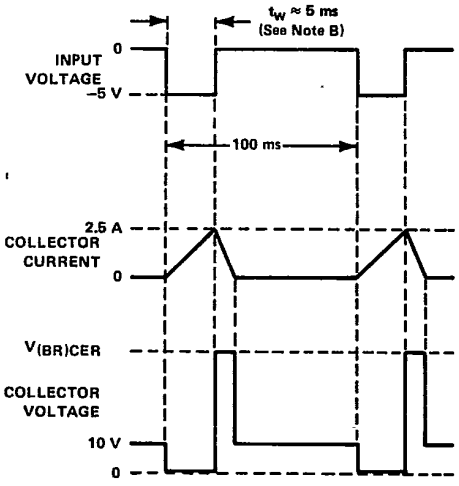
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTES: A. L1 and L2 are 10 mH, 0.11 Ω, Chicago Standard Transformer Corporation C-2688, or equivalent.
B. Input pulse duration is increased until I_{CM} = 2.5 A.

FIGURE 2. INDUCTIVE-LOAD SWITCHING

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TYPICAL CHARACTERISTICS

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

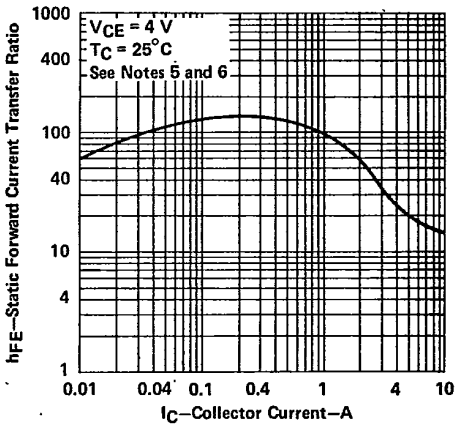

FIGURE 3

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2%.
6. These parameters are measured with voltage-sensing separate from the current-carrying contacts.

MAXIMUM SAFE OPERATING AREA

FORWARD-BIAS SAFE OPERATING AREA

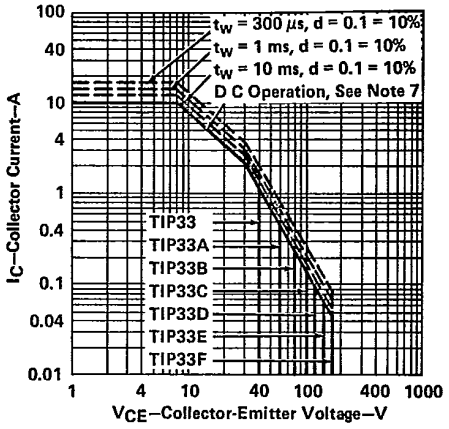

FIGURE 4

NOTE 7: This combination of maximum voltage and current may be achieved only when switching from saturation to cutoff with a clamped inductive load.

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THERMAL INFORMATION

DISSIPATION DERATING CURVE

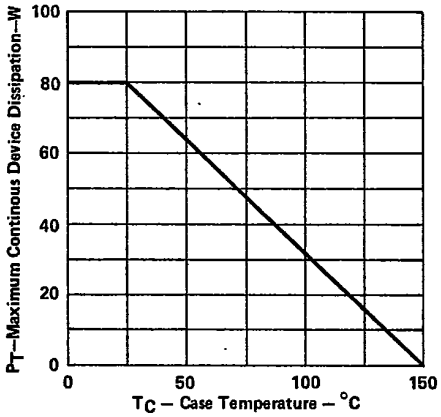

FIGURE 5